in the future if there is a continuation of current management direction Pursuant to NEPA procedures, this alternative Shall be deemed the "No Action" Alternative

h Each alternative shall represent, to the extent practicable, the most cost-efficient combination of management prescriptions examined that can meet the objectives established in the alternative

i Each alternative shall state at least the condition and uses that will result from long-term application of the alternative, the goods and services to be produced, the timing and flow of these resource outputs together with associated costs and benefits, the resource management standards, and the purposes of the management direction proposed

2. Analysis Process

a *Introduction*

Forest planning is a complex process which requires the evaluation of an enormous amount of information This evaluation occurs in a series of steps which utilize specific tools and techniques to facilitate the analysis of data

The planning regulations and agency direction emphasize the use of economic efficiency criteria in the major analytical phases of the planning process The development of management prescriptions and the analysis of benchmarks, management constraints and alternatives are steps which focus on cost-efficiency and the calculation of economic and resource trade-offs

The amount of data needed for these analyses and the complexity of analyzing the important economic and resource relationships on the Malheur National Forest requires the use of computer models The central tool used to conduct these analyses was a linear programming model called FORPLAN (an acronym for FORest PLANning, Johnson and Crim, 1986) Other models were used to develop input data for FORPLAN and to conduct additional analyses after FORPLAN solutions were obtained

The following sections briefly describe the analytical process and tools used by the Malheur National Forest during the planning process, and the analysis performed Reviewers are encouraged to refer to Appendix B for a more complete and technical discussion of *the analysis process*

b *The FORPLAN Model*

The Malheur National Forest used FORPLAN Version 1, to conduct the required analysis in the land management planning process The FORPLAN model is a comprehensive, computerized, mathematical optimization model capable of analyzing the economic and resource relationships associated with management of the Forest. It is a linear programming model designed to assist in the identification of the particular combination of land assignment, management prescriptions, and activity schedules that best meet the objectives of each benchmark or alternative

FORPLAN is composed of a matrix generator, a linear programming solution system, and a report writer. Within the bounds of the matrix generator and the Functional Mathematical Programming System, the user is allowed a great deal of latitude in formulating the mathematical representation of the Forest planning problem to be analyzed The FORPLAN model was specifically designed to assist the interdisciplinary planning team analyze the economic and production trade-offs associated with recreation, timber, scenery, old growth, water, roadless, and wildlife resources, and to evaluate the extent to which various alternative management scenarios were able to address and resolve the identified planning issues

c. *Analysis Areas*

The basic building blocks of the FORPLAN model are the analysis areas Analysis areas are tracts of land with relatively homogeneous characteristics in terms of the outputs and effects that are being analyzed in the FORPLAN model Their delineations were intended to capture the significant social, biological, and economic differences in the way the land responds to alternative management strategies A total of 168 analysis areas were identified on the Forest. These represent combinations of slope class, timber type (i.e., species group), resource condition class, roading level, riparian status, major watershed, and range attribute (ie., winter range versus spring-summer-fall range).

d. *Changes from Draft to Final Environmental Impact Statement*

For all EIS alternatives, the analysis area scheme was reworked to include seven major watersheds in order to make the FORPLAN model more geographically specific In order to keep the number of analysis areas within the FORPLAN maximum limit of 800, some of the other parameters were simplified. Details of the revised structure are given in Appendix B.

e *Prescriptions*

Two major categories of prescriptions were used in the analysis A management prescription is a set of management practices and their schedule for application to a specific analysis area to achieve a particular objective The prescriptions describe the available choices which can be made in managing the analysis areas The selection of a prescription for a particular analysis area is based on the objectives of a particular alternative, the production potentials of that analysis area, and the benefits and costs of implementing the prescription on the analysis area.

Prescriptions were developed to represent the range of management opportunities to respond to the issues, concerns, and opportunities.

The second category of prescriptions, called FORPLAN prescriptions, contain the details necessary to model the management prescriptions in FORPLAN, and to schedule activities in a cost-efficient manner.

FORPLAN prescriptions are combinations of scheduled activities and practices, and their associated outputs and effects These prescriptions and their range of timing choices are represented as decision variables in FORPLAN The outputs and effects associated with the prescription choices are represented as mathematical coefficients in the respective decision variables.

FORPLAN prescriptions are represented at three levels within FORPLAN. At the first level, a set of management emphases parallel the management prescriptions. Within many management emphases a set of management intensities are represented as choices in the FORPLAN model These intensities depict different combinations of activities such as timber harvesting, planting, commercial thinning, etc At the third level, dozens of different timing patterns and rotation ages were provided for most management emphasis/management intensity combinations on timbered lands.

Mathematical estimates of the economic costs and benefits and resource outputs (yields) were developed for use in the FORPLAN model Some yields were developed through use of other computer models Timber yields came from a yield simulator (STAND PROGNOSIS model - Wykoff et al 1982) A rigorous analysis of timber prescriptions ensured that the most cost-efficient, and those that produced the most timber volume on a per acre basis, were included in the Forest-wide analysis in FORPLAN.

Operation of the FORPLAN model was designed to ensure that prescriptions and timber management options were selected in a cost-efficient manner (see Appendix B, Section III.D and Section III E for more information on the Stage II analysis of FORPLAN timber management prescriptions). The prescriptions FORPLAN selected depended upon the objective function and the set of constraints used to represent a particular benchmark or land management alternative. The objective function is a mathematical equation which

shows how the Forest's objective (maximum present net value, for example) is affected by the variable values explicitly portrayed in alternative management prescriptions. Constraints are mathematical equations which require that a given amount of an input or output variable be achieved The given amount is also termed the right-hand side due to its location within typical matrix representations. All constraints must be satisfied before an optimal solution to the objective function is reached

The objective function was usually to maximize present net value, production of timber, production of cover, or production of forage. These were subject to first satisfying all the specified constraints. Constraints were designed to guarantee the spatial and temporal feasibility of land assignment and harvest scheduling choices in order to achieve the multiple use objectives of a benchmark or alternative Once the model determined that a feasible solution existed by satisfying all of the constraints, it searched for the set of prescriptions and timing choices which permitted it to optimize the solution according to the specified objective function.

f *Management Areas*

A management area is a grouping of analysis areas to be managed with similar management goals, objectives, and standards; i e , assigned the same management prescription. Management areas are identified to display the management emphasis for identifiable areas of the Forest

Management areas are the building blocks of alternatives By assigning land to a particular management area, the on-the-ground management to result from that alternative becomes apparent The assignment of lands to management areas identifies the types and amounts of management activities that can occur on specific areas of the Forest.

A total of 22 management areas have been identified to portray the different ways of managing the Forest The management goals for the management areas range from managing for timber production and other multiple uses on a sustained yield basis (Management Area 1), to managing to protect or enhance riparian-dependent resources (Management Area 3), to managing for developed recreation opportunities (Management Area 12). These management areas are described in Section B.5 of this chapter

g. *Using FORPLAN to Analyze Alternatives*

The base data used in applying FORPLAN analysis to optimize efficiency while meeting objectives of each alternative were the analysis areas, alternative prescriptions, time periods, resource constraints, estimates of resource output objectives in quantitative terms from applying prescriptions within analysis areas, estimates of the unit costs required to implement prescriptions on analysis areas, and unit benefit estimates for the outputs produced Based on this information and the objectives of an alternative, FORPLAN analysis determines which prescriptions to apply to which analysis areas and when to schedule them for application. However, the management area assignments, which are for the most part fixed for each alternative, determine which prescriptions are available for each analysis area The assignment of land to management areas essentially constrains selection of prescriptions within analysis areas The management area assignments do vary from alternative to alternative, however (See Table II-4 following the management area descriptions for acres by alternative)

In the Forest's FORPLAN model, the outputs which are modeled as a function of applying prescriptions to analysis areas include timber, forage, cover, sediment, road construction, road reconstruction, acres of precommercial thinning, and volume of ponderosa pine harvested. These outputs were chosen because of their relationship to the issues Other outputs and effects are estimated outside of the FORPLAN model or by interpreting the results of the FORPLAN solution.

Because of model and computer limitations it was not practical to include all resource interactions in the FORPLAN model In addition, many of the resource interactions

related to the alternatives do not fit well into a linear programming format. Thus, many of the elements of the alternatives are handled outside of the FORPLAN model or used to develop constraints applied for particular alternative formulation For more discussion of the Forest's FORPLAN model see Appendix B

An initial major, step in formulating an alternative with FORPLAN is the assignment of all Forest lands, by analysis area, to the various management areas This decision is critical because the management area determines what range of prescriptions or management choices are available for that piece of land

Present Net Worth on a per acre basis, referred to as Financial Analysis (Stage II–required by 36 CFR 219.14 [b]) was done in the analysis process for all analysis areas and associated management prescriptions prior to the Draft Environmental Impact Statement. See Appendix B, Section III.E for a detailed description.

The prescription choices that are available for each management area are shown in Table II-1. As shown, a full range of timber prescriptions are available for Management Areas 1, 4A, 4B, 18 and 20. For Management Areas 3 and 14, a more limited number of prescriptions are available with reduced timber yields to meet other resource objectives Management Area 2 is used for primary grazing lands, so no timber prescriptions are available there.

For practical purposes, the management area assignments for each alternative are fixed as part of the design of the alternative. That is, the management area assignments are not assigned by FORPLAN but are constrained into each alternative FORPLAN formulation to achieve the particular objectives of each alternative There is a minor exception to this however. Whenever an analysis area, or piece of analysis area, is assigned to a management area that involves scheduled timber harvest, the FORPLAN model is given the choice of assigning that land to a minimum level management area prescription (Management Area 16)

The management areas for which the assignments are absolutely fixed include Management Areas 5 through 13, 17, 19, and 21 Analysis areas which are assigned to Management Areas 1 through 4B, 14, 18, 20 and portions of 22 always have the option of assignment to minimum level management

In addition to the management area prescription assignments there are other fixed prescription assignments that are significant in determining outputs and effects within an alternative and its management areas These are shown below

a. Management strategies of range allotments,

b. Riparian area management strategies,

c Amount of fish habitat improvements,

d Amount of developed recreation facilities constructed,

e Amount of forage seeding following timber harvest;

f Snag and snag replacement levels,

g. Amount of wildlife habitat improvements,

h. Amount of trail construction and reconstruction, and

i Acres of each wilderness assigned to each wilderness recreation opportunity spectrum

The target levels of each of the resource objectives and related outputs, with the exception of some timber and range outputs, are not "chosen" by the FORPLAN model for each alternative but are the prescribed design elements of each alternative. These are modeled as constraints in each alternative FORPLAN formulation or are calculated and estimated outside of FORPLAN

While the management area assignments and other resource design elements are essentially fixed for each alternative, they do vary across the range of alternatives In this way the outputs, effects, and trade-offs associated with each alternative can be analyzed and evaluated comparatively with all other alternatives to identify the alternative that comes nearest to maximizing net public benefits while responding to public issues.

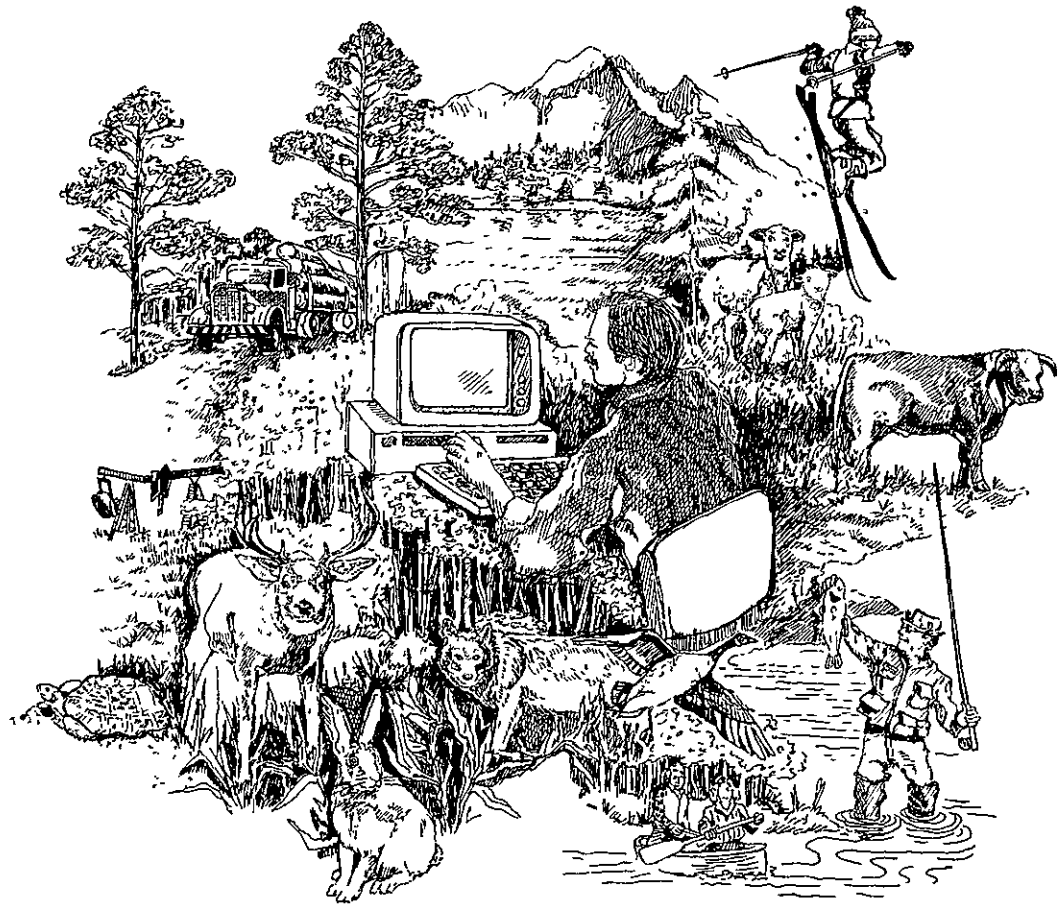

TABLE II-1: Summary of Prescription Choices Available for Each Management Area

Management Area	PRESCRIPTION CHOICE							
	Clearcut		Shelterwood		Overstory Removal		Uneven-aged	Min Level (No Sched
	With Thinning	Without Thinning	With Thinning	Without Thinning	With Thinning	Without Thinning	Selection Harvest	Timber Harvest)
1. General Forest	X	X	X	X	X	X	X	X
2 Rangeland								X
3A. Non-Anadromous Riparian Areas[a/]	X[1/]	X[1/]					X	X
3B Anadromous Riparian Areas[a/]	X[1/]	X[1/]					X	X
4A. Big-Game Winter Range Maintenance	X	X	X	X	X	X	X	X
4B. Big-Game Winter Range Enhancement	X	X	X	X	X	X	X	X
5. Bald Eagle Winter Roosts[b/]								X
6A. Strawberry Mtn Wilderness[b/]								X
6B. Monument Rock Wilderness[b/]								X
6C. Pine Creek Wilderness[b/]								X
7. Scenic Area[b/]								X
8. Special Interest Areas[b/]								X
9. Research Natural Areas[b/]								X
10. Semi-Primitive Non-Motorized Recreation Areas[b/]								X
11. Semi-Primitive Motorized Recreation Areas[b/]								X
12. Developed Recreation[b/]								X
13 Old Growth[b/]	X[2/]	X[2/]	X[2/]	X[2/]			X[2/]	X
14. Visual Corridors[a/]	X[3/]	X[3/]			X[3/]	X[3/]	X	X
15. Unit Plan Wildlife Emphasis Areas	X	X	X	X	X	X		X
16. Minimum Level Management								X

1/Prescriptions are available only in lodgepole pine stands in riparian areas

2/Prescriptions for timber harvest options applicable only for old-growth replacement stands

3/Prescriptions are available only in lodgepole pine stands in visual corridors

a/Scheduled timber harvest allowed varies by alternative design to meet other resource objectives

b/The acres assigned to this management area are fixed in each alternative (i e there is no choice in the FORPLAN model), but do vary by alternative

TABLE II-1: Summary of Prescription Choices Available for Each Management Area (continued)

Management Area	PRESCRIPTION CHOICE							
	Clearcut		Shelterwood		Overstory Removal		Uneven-aged	Min Level (No Sched
	With Thinning	Without Thinning	With Thinning	Without Thinning	With Thinning	Without Thinning	Selection Harvest	Timber Harvest)
17 Byram Gulch Municipal Supply Watershed								X
18. Long Creek Municipal Supply Watershed	X	X	X	X	X	X	X	X
19 Administrative Sites								X
20 Wildlife Emphasis With Scheduled Timber Harvest[a/]	X	X	X	X	X	X	X	X
21 Wildlife Emphasis With Non-Scheduled Timber Harvest								X
22 Wild and Scenic River [c/]	X[4/]	X[4/]					X	X

4/ Prescriptions are available only in lodgepole pine stands in scenic corridors

c/ Scheduled timber harvest allowed only within scenic portion of designated river corridors Wild designations limited to Minimum Level prescriptions only

h. *Additional Analysis Tools*

Although FORPLAN was the central model in the analysis process, several other models were essential to either prepare data for FORPLAN, or help interpret FORPLAN results Construction of managed timber yield tables for use in FORPLAN required use of a computerized growth model (PROGNOSIS model).

IMPLAN is a Forest Service designed computer model that estimated the expected economic effects of implementing one or more alternatives IMPLAN contains national economic data that have been organized into a single predictive model. The basis for prediction can be any single U S county or group of counties, any state, or the entire nation Regardless of how the model is constructed (county or multiples of counties), IMPLAN provides a detailed description of the economy in question. The model then provides analytical information about the industries that are present and their relationship to other industries. Thus, changes in any of the industries, as caused by the alternatives, result in measurable changes in the socioeconomic area of influence.

The economic effects estimated with IMPLAN are described by parameters typical of input/output studies They are structural in nature, permitting multiplier effects to be traced throughout the various regional sectors Direct, indirect, and induced changes in gross outputs, employment, income, and value-added are the most representative account of potential regional economic impacts This information was used to portray the Forest Service's relationship to the area economy and to help assess the effects on that economy of alternative management programs

The Forest Service ADVENT program and mimic spreadsheet was used to fully calculate present net value, costs, benefits, and other information such as net cash flow Additional models were built locally to analyze the effects of FORPLAN solutions.

The Forest Service ADVENT program and mimic spreadsheet was used to fully calculate present net value, costs, benefits, and other information such as net cash flow. Additional models were built locally to analyze the effects of FORPLAN solutions

Big-game habitat capability and population trends were computed based on an elk winter range Habitat Effectiveness Index (HEI) model devised by Thomas et al. (1988), and the model was applied to both summer and winter ranges See Appendix B, Section III G, for further discussion of the model

3 The Analysis of the Management Situation (AMS) and Benchmark Analysis

The first step in developing alternatives was to look at current information about the various market and nonmarket outputs which the Forest could provide; the range within which multiple use alternatives could be developed was defined These limits are called benchmarks because they define this "decision space "

The resource and economic potential of the Forest was identified by a set of eight management scenarios called benchmarks, as required by 36 CFR 219.12(e) These benchmarks identified potentials under current management direction, as well as under present legal requirements (i e , Management Requirements - MRs) and regulations on timber harvest (e g , culmination of mean annual increment). In addition, present net value is maximized because it is such an important part of defining net public benefits.

The benchmarks summarized are described in detail in the Benchmark Formulation section of Appendix B, and the outputs and effects associated with these eight benchmarks are also displayed in Appendix B Following the summary of each benchmark, Figure II-1 displays the decision space for five major indicators–timber sale program quantity, present net value (PNV), big-game use, anadromous fish commercial harvest, and permitted grazing.

The benchmarks considered in this analysis were

Minimum Level Management - Determines the minimum costs (with resultant outputs and effects) necessary to retain the National Forest lands in federal ownership, subject to certain environmental constraints and protection of life, health, and safety of incidental users.

Present Net Value (PNV Assigned) - Estimates the Maximum Present Net Value (Max PNV) that might be attained by maximizing the net value of market resources under a nondeclining evenflow policy, and assigning values to the production and output of all nonmarket resources (see Glossary for market and nonmarket resources) This benchmark serves as a basis for an economic comparison between benchmarks and alternatives, as well as a basis for determining the effects of various constraints on outputs and costs.

Present Net Value (PNV Market) - Estimates the Maximum Present Net Value that might be attained by maximizing the net value of market resources under a nondeclining evenflow policy The difference between this benchmark and the present net value (assigned) benchmark is that this benchmark does not assign values to the nonmarket resources such as wildlife habitat, visuals and other resources that are not sold in a market.

Current Direction - Estimates the outputs and effects of maintaining direction and policy found in existing unit plans, timber and other resource plans, special area management plans, and Malheur National Forest policy This benchmark provides the basis for the No Change and No Action Alternatives. (Outputs are reported for the No Action Alternative in Figure II-1 and Table II-1)

Max Timber - Defines the highest sustainable timber harvest levels for the Forest, subject to legal requirements for other resources and nondeclining evenflow policy. The